WHARF PROTECTION

AGAINST

TEREDO AND LIMNORIA

ILLUSTRATED

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WHARF PROTECTION

AGAINST

TEREDO AND LIMNORIA

BY

H. L. GULLINE & CO., SEATTLE, WASH.

LOWMAN & HANFORD STATIONERY
AND PRINTING CO.

FEB 17 1892
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PREFACE

As agents throughout the State of Washington, and the Province of British Columbia, for the Paraffine Paint Company of San Francisco, California, we herewith present a review of their process of protecting submerged timber against the ravages of teredo and limnoria, together with a description of the animals themselves, their classification and habits.

In consequence of the large number of letters received, asking for every kind of information concerning the P. & B. Pile-Covering, we respectfully submit the following.

H. L. GULLINE & Co.

Seattle, Wash., Dec., 1891.

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TEREDO and LIMNORIA

THE generally accepted theory with regard to the advent of teredo and limnoria upon our shores, is that in the early commercial history of the Pacific Coast, vessels trading between the Orient and California, carried them over secreted in their hulls, and that their eggs were deposited while the ships lay at the wharves.

It is not denied that shipping, driftwood and wreckage may have assisted in disseminating them to a certain extent, but the prevailing idea that their presence is due entirely to such causes is absolutely erroneous. They are purely the result of a natural law, and are found in all seas of the world where the prevalence of timber presents a field for their labor.

Before giving a brief description of them, together with their manner of operating, we beg to thank Professor Orson B. Johnson of the State University, Seattle, for his kind information in regard to their classification.

TEREDO AND LIMNORIA

THE TEREDO

Branch	*Mollusca*	Shell Fish
Order	*Pelycypoda*	Bivalves
Family	*Pholadidæ*	Shielded Borer
Genus	*Xylotrya*	Wood Burrower
Species	*Fimbriata*	Fringed

The teredo when full grown varies on this coast from ten to eighteen inches in length; its body which is semi-transparent and of a bluish-white color, is soft like that of a jelly fish, and about twice as thick as an ordinary lead pencil. The boring extremity (erroneously called the head), is composed of two shells, concave on the under side, and running to sharp points at the top, forming a perfect auger, in the center of which is the *foot*, a sucker used in transferring the wood borings to the stomach. Two siphons run the entire length of the animal, one being used to supply the water necessary for softening the wood and preventing friction in the process of boring, and the other as a channel through which the digested particles are discharged. The so-called tail remains at the aperture by which the animal originally entered, and consists of two flat plates from an inch to two inches long, called the *pallets*, which are fringed on both sides with short feathery particles, giving them the appearance of arrow heads. A common ligament connects the pallets with the body, and enables them to

SPLIT SECTION OF PILE,
SHOWING TEREDOS AND THEIR BURROWS

be worked backwards, presumably to admit of free action to the siphons, whose extremities lie between them.

Their cells or burrows are lined with a smooth calcareous film, and incline inward and upward, but in spite of the fact that thousands of teredos attack the same pile, no two burrows ever meet, though the intervening walls are frequently no thicker than a sheet of paper.

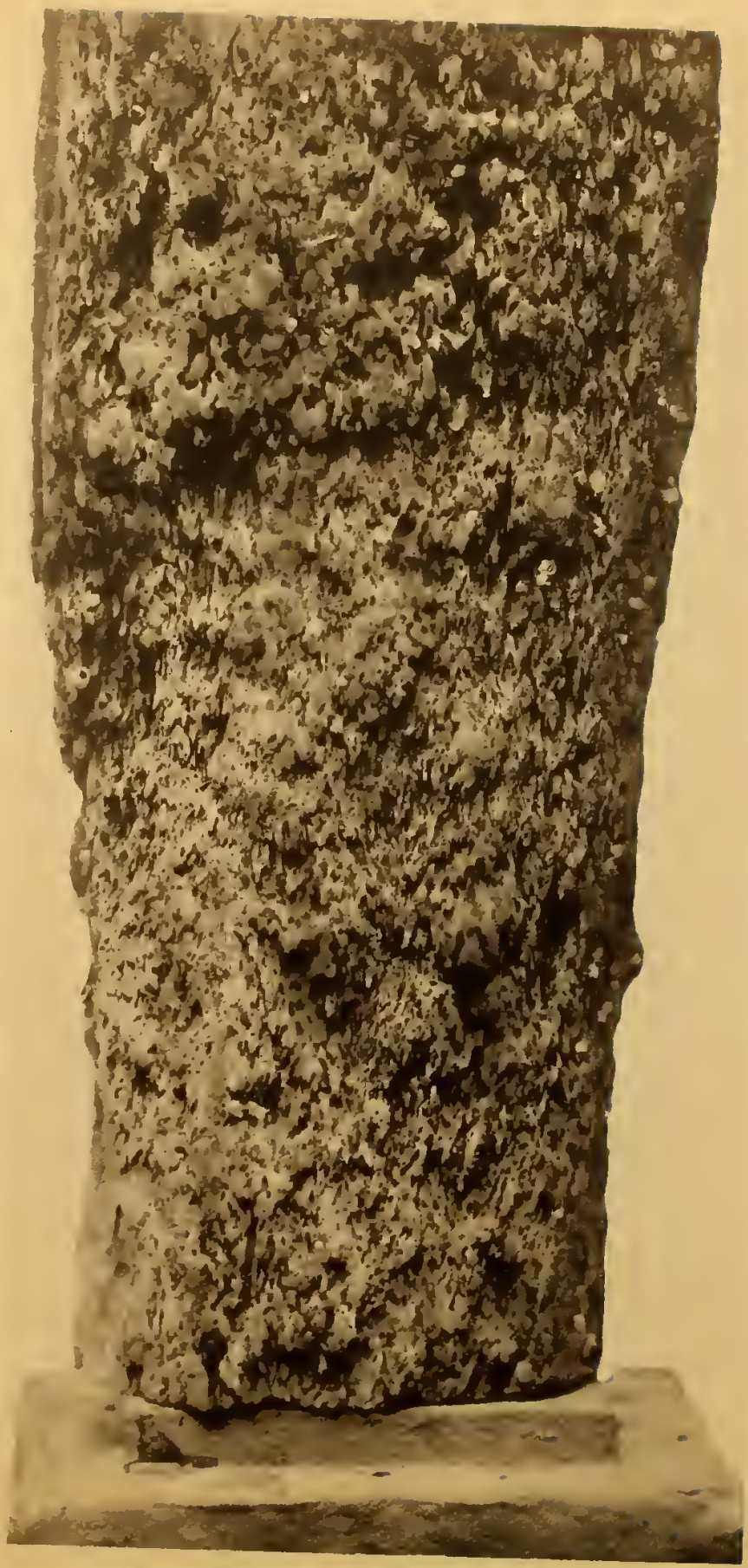
According to Quatrefages, the larvæ in their primary stage, consist in minute form of the shell or boring portion only, and that by means of the foot protruding therefrom, they attach themselves to the timber during the process of rasping an ingress.

Once an entrance is effected, their growth is very rapid, attaining the maximum in from eight to twelve months.

THE LIMNORIA

Branch	*Arthropoda*	Jointed Limb
Order	*Tetradecapoda*	Fourteen Footed
Family	*Oniscoidea*	Resembling a Wood-louse
Genus	*Limnoria*	Wood Eater
Species	*Terebrans*	Perforator

This louse is a short, flat, oval crustacean, from an eighth to a quarter of an inch long, and strongly resembles the sow-bug or pill-bug. The back at the extremities is almost square,



SECTION OF LIMNORIA EATEN PILE

and segmented like that of a lobster. It is provided with four fimbriated antennæ, those next the head being longer and thicker than the outer ones; these feelers constitute the organs of touch and hearing. It has fourteen legs, fimbriated like the antennæ, and terminating in strong, horny claws, by which it obtains a firm grip on the wood while eating it.

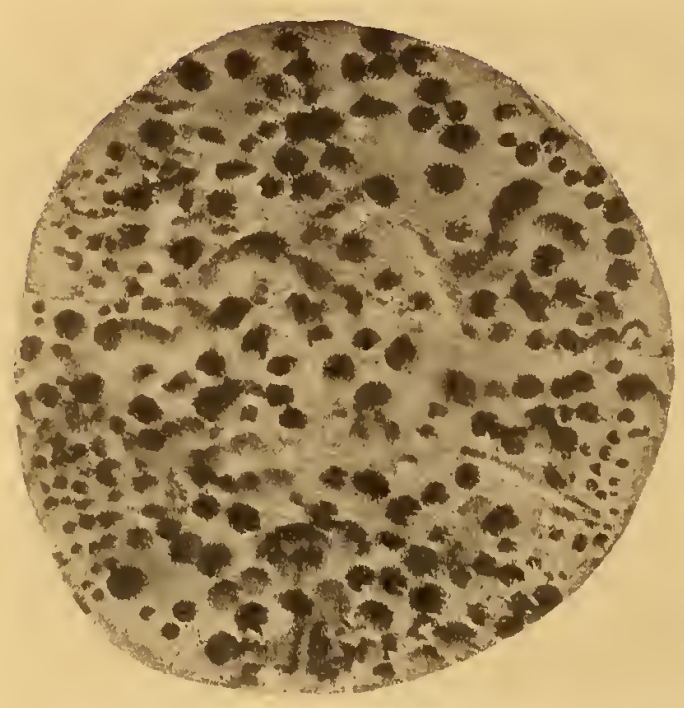
Myriads of these creatures attack a pile, confining their operations to that surface which lies between high and low water. While they are not as commonly found, they are quite as destructive as their co-workers the teredos, although their mode of attack and the effect produced on the timber are entirely dissimilar. Attaching themselves to the surface, they perforate and eat the wood from the outside, literally cutting it in two, so that oftentimes part of the pile will be left hanging from the cap, while that portion of it beneath low tide mark, is entirely free from their action.

Very little definite information is obtainable concerning the original form of the larvæ, but it is authentically known that they strongly resemble the parent during the subsequent metamorphoses.

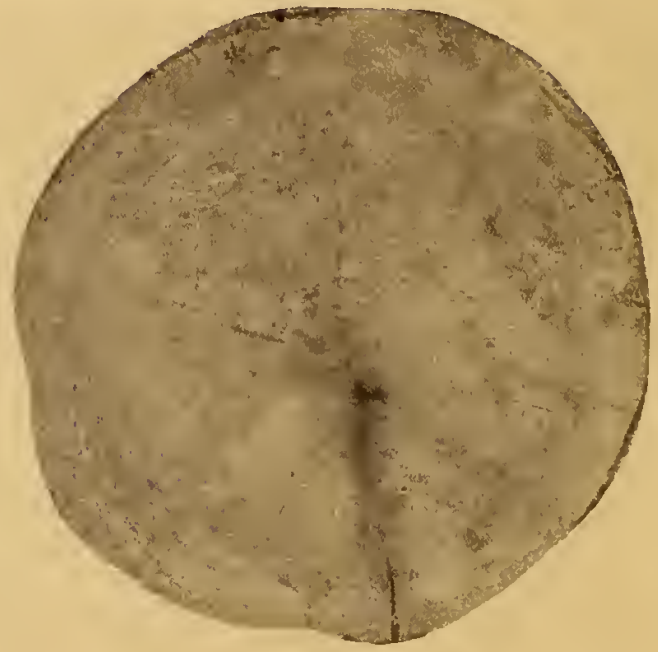
Our illustrations on pages 10 and 12 are from photographs of two sections taken from Seattle Harbor, showing the condition of piles after several months' exposure to the ravages of teredo and limnoria.

No. 1. Section of UNPROTECTED pile from San Francisco Bay, submerged FOURTEEN MONTHS. Completely ruined.

No. 1



No. 2



No. 2. Section PROTECTED by the P. & B. Pile Covering, showing the condition of piles at the same place after SEVEN YEARS and SIX MONTHS submersion. No deterioration whatever in the covering, and the piles sound throughout.

The P. & B. Pile-Covering

NEARLY eight years have elapsed since letters patent were issued for what is now widely known as the P. & B. Pile-Covering, so called from the initial letters of the inventors' names, Messrs. Pearce and Beardsley of San Francisco, California.

It is made of heavy jute cloth, thirty-three inches wide, thoroughly saturated with P. & B. pile compound, and lined on the inner side with manilla to prevent the surfaces from adhering in the process of its manufacture. Being prepared under immense pressure, it is uniform throughout, and remains pliable at all times, thus facilitating the work of its application.

Many who had noticed the disastrous terminations of various pile armours, and who in consequence were at first sceptical as to the ultimate success of this invention, have since had every shadow of doubt removed, and indorse it to-day as the best and most economical protection against marine animals which has yet been devised.

The life of unprotected piles on this coast varies according to locality from six to eighteen months, and the fact that this covering has withstood the corrosive action of the salt water, as well as the attacks of its still more destructive inhabitants, the teredo and limnoria, for seven years and six months, is the best possible evidence of its effectiveness and durability. It is now used by most of the leading railroad companies on the coast, and has lately been adopted in preference to all other protections by the California State Board of Harbor Commissioners,

who during the last eighteen months have used it in covering over 100,000 lineal feet of piles, driven in San Francisco Bay.

The materials from which it is made are absolutely insoluble in salt water, so that in spite of the length of time it has been submerged, it still remains intact, without the slightest sign of deterioration or decay. Can as much be said of other pile protections? We think not.

COPPER

Even copper, the cost of which is prohibitive ($1 to $1.10 per lineal foot applied), is frequently cut by the fine film of sand carried on the surface of advancing and receding waves, thus leaving an opening which eventually means the destruction of the pile. P. & B. covering is not subject to this friction, because, unlike the metal which always remains clean, it is a fertilizer, and rapidly becomes thickly coated with grass, mussels and other shellfish, which, besides being entirely harmless to the material, act as an additional protection.

CREOSOTE

Contrasted with this process, P. & B. Covering has the decided advantage, not only as regards the great difference in cost (see page 23), but also in serviceableness. It is a fact well known to those who have studied the subject, that the operation of creosoting destroys in a great measure the texture of the pile and robs it of its virtue, rendering it brittle, brash, and unfitting it for driving in ordinarily hard bottoms. This is the unavoidable sequence of the cooking it receives in the retorts before the creosote is forced into it.

The following extracts from absolutely disinterested reports, show in what estimation creosote as a pile preservative is held by the highest English and American authorities:

Mr. Thomas Stevenson, one of Great Britain's most reliable maritime engineers, writes as follows in Chapter 10, page 197, of his work entitled "The Construction of Harbours:"

"The creosote process was recently employed in the construction of timber work subject to the attacks of marine insects. It was found that the woody fibre was eaten, even although the outer skin had suffered no injury after leaving the tank; at Scrabster, Invergordon and other places where the timber was thoroughly treated with creosote, *it had been very much destroyed by the teredo, which undoubtedly eats the timber freely, even though it be still black with creosote and continue to emit its pungent odor.*"

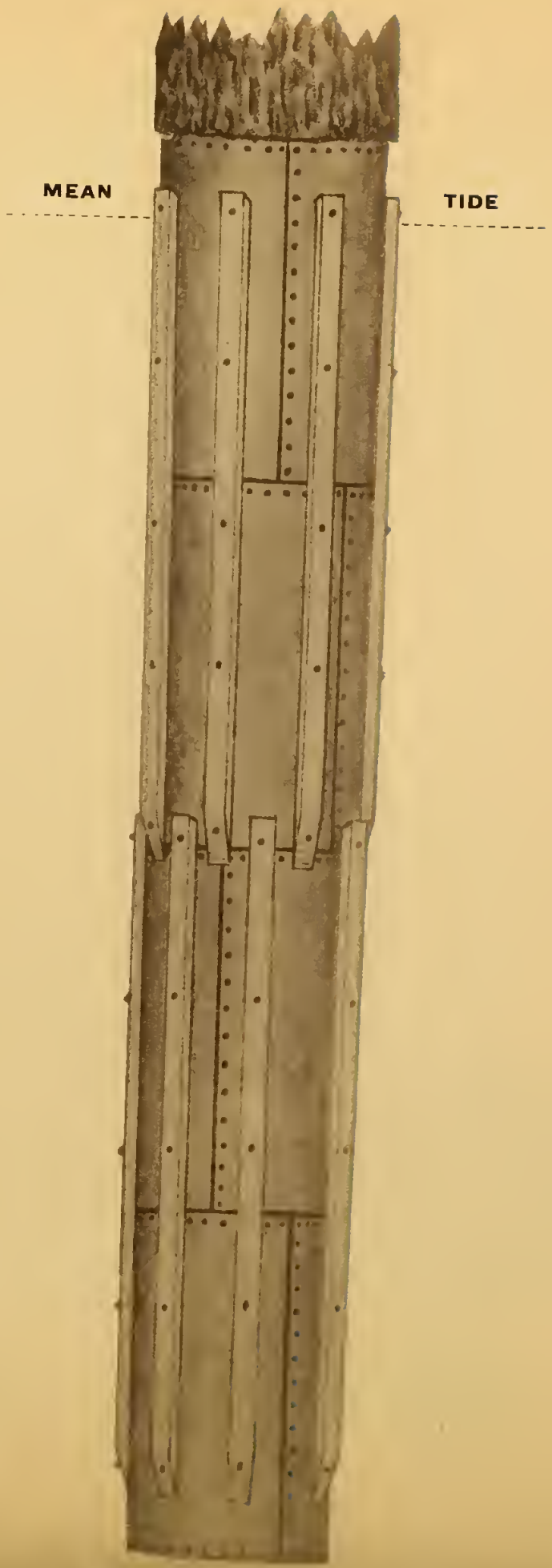
Lieutenant Sears of the U. S. Engineering Corps, who was in charge of the construction of the Wilmington breakwater, reports as follows in Volume 5, page 388, of "Transactions of the American Society of Civil Engineers:"

"During a four years' experience at Wilmington breakwater, California, over a million feet of our timber was treated with creosote. *It utterly failed to protect the timber from the worms. I have no confidence whatever in the creosoting of timber for its preservation from worm attack, and my observation at Wilmington and elsewhere leads me to consider it an utter failure.*"

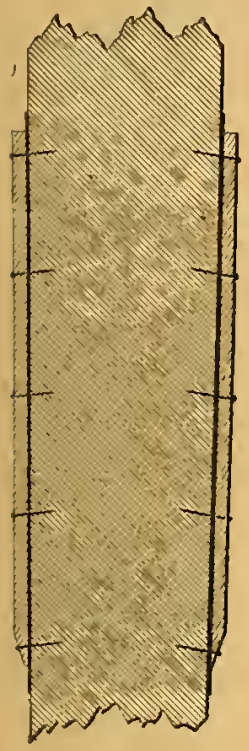
GREAT NORTHERN R'Y CO. APPLYING THE P. & B. COVERING AT SEATTLE

Mode of Applying the P. & B. Covering

FIRST lay the piles on stringers in order to raise them about a foot above the ground, so that they may be easily rolled backwards and forwards. Remove the bark, all knots and protuberances, leaving the surface smooth and round, from about a foot below mud line to midway between high and low water (mean tide). The object of protecting about a foot in the mud, is to allow for the usual shallow basin formed at the base of piles by crabs and other crustaceans, as well as by the rise and fall of tide. After allowing from three to four hours for the sap to cease exuding from the newly peeled wood, paint the barked space thoroughly with P. & B. compound, which is applied cold, and needs neither stirring nor mixing. **WHILE THE PAINT IS WET** (*it dries very quickly*), nail on the covering, commencing at the top of the pile, allowing $1\frac{1}{2}$ inches on overlaps, and using $1\frac{1}{4}$ inch copper or yellow metal nails, placed about $1\frac{1}{2}$ inches apart round both ends and on all overlaps. Another good coat of the compound is then applied over the covering and nail-heads, and 1 x 2 inch battens, 5 feet


MEAN
TIDE

long and sharpened at the lower ends, are nailed with 10d wire nails to the top 10 or 15 feet of the covered space, in order to prevent abrasion in the gins of the pile-driver. Our illustration on page 20 shows the top 10 feet of a pile properly covered and battened; the lower portion should be covered in precisely the same way, but without battens. Six battens are sufficient to go round a pile from 12 to 14 inches in diameter, and the nails used on them should be placed about a foot apart, and incline slightly upwards (see cut), in order to counteract the effect of the stroke of the pile hammer. Strong iron pincers of the shape shown in the cut, are used to draw the covering tightly round the pile, so that it may hug it closely, leaving no bulges, and virtually form a false bark. These pincers which can be made by any blacksmith, should have grips 34 inches wide *in the clear*, so that the material which is 33 inches in width may *freely* pass between them.



If any evidence of limnoria is ever found between mean and high tide, the unprotected space can be easily covered without disturbing the pile.

Cost of Protecting Piles by the P. & B. Process.

Exclusive of original cost of the piles.

Estimate on covering 100 piles, 46 feet long, averaging 14 inches in diameter.

Depth of water at mean tide 18 feet. Length of pile in mud 15 feet. Length of pile from cap to mean tide 13 feet.

Piles protected from 1 foot below mud line to mean tide (19 ft.). Total, 1,900 lineal feet to be protected.

P. & B. COVERING (33 inches wide), 950 yards One yard covers 2 lineal feet, 14 inches in diameter.	@	35c	$332.50
P. & B. PAINT (Pile Compound), 95 gallons One gallon covers 20 lineal feet, one coat on the barked space, and one coat over the covering.	@	1.00	95.00
YELLOW METAL NAILS (1¼ inch) 144 nails to 1 pound, 259 lbs. One pound covers 7⅓ lineal feet, 1½ inches apart round the ends, and on all overlaps.	@	21c	54.39
BATTENS (1 x 2 inch), 1000 feet, board measure Each pile battened 10 feet, 6 battens to the circumference.			8.00
TENPENNY WIRE NAILS, 87 nails to 1 pound, 224 lbs. One pound covers 8½ lineal feet, placed 1 foot apart on battens only.	@	4c	8.96
FREIGHT on Covering & Paint from San Francisco to Puget Sound or B. C.			14.00
LABOR (liberal estimate), 1900 lineal feet	@	6c	114.00
			$626.85

TOTAL COST, a fraction less than 33 Cents per lineal foot protected.

Having covered hundreds of piles by the P. & B. Process, we endorse the above as a correct estimate of cost.

NORTHERN PACIFIC R. R. CO.,
A. RYDSTROM,
Ass't Engineer.

GREAT NORTHERN RY. CO..
A. G. SCURFIELD,
Ass't Engineer.

OREGON IMPROVEMENT CO.,
B. F. BUSH,
Chief Engineer.

Comparative Expense of Protecting Piles With

Copper, Creosote and P. & B. Pile-Covering.

Exclusive in each case of original cost of the piles.

Estimate on protecting 100 piles, 46 feet long, averaging 14 inches in diameter.

Depth of water at mean tide 18 feet. Length of pile in mud 15 feet. Length of pile from cap to mean tide 13 feet.

Protection needed from 1 foot below mud line to mean tide (19 ft.). Total, 1,900 lineal feet needing protection.

COPPER

COPPER, 1900 lineal feet	@	1.00	$1900.00
P. & B. COVERING, 1900 lineal feet (see page 22)			626.85
			$1273.15

DIFFERENCE IN FAVOR OF P. & B. COVERING, $1273.15 (over 203 per cent.)

CREOSOTE

* **CREOSOTE,** 100 piles, 46 × 5 ft. = 51 ft. each. Total, 5100 lineal feet	@	25c	$1275.00
P. & B. COVERING, 1900 lineal feet (see page 22)			626.85
			$648.15

DIFFERENCE IN FAVOR OF P. & B. COVERING, $648.15 (over 103 per cent.)

* NOTE.—Creosoting invariably makes the piles very brittle, so that thay split and shiver a great deal in driving. and the above allowance of 5 feet on each pile for cut-off, will be found to be under rather than over estimated.

NORTHERN PACIFIC RAILROAD COMPANY.

TACOMA, Wash., September 27, 1890.

Gentlemen:—

We have used your P. & B. Pile-Covering in Coal Bunker No. 3 in Tacoma, the same having been in service 20 months. On examination we find no evidence of the action of the teredo, the covering still remaining intact in all instances. We are now using your process for about 75,000 lineal feet of pile foundations in and about Tacoma.

So far as my experience goes, after having tried many different schemes, this is the best I know of.

Yours truly,

H. S. HUSON,

Prin. Ass't Engineer.

NORTHERN PACIFIC RAILROAD COMPANY.

TACOMA, Wash., December 2nd, 1891.

Gentlemen:—

The Northern Pacific Railroad Company has used your P. & B. Paint and Covering on the piles used in coal wharf No. 3.

In all this company has covered by the P. & B. process about 75,000 lineal feet of piling.

In coal wharf No. 3, some piles covered by your process have been in the water a little over 3 years, and upon examination they were found to be in perfect condition, without any sign of teredo.

The ordinary life of a winter cut pile at coal wharf No. 3 has been from 10 to 18 months when not protected.

E. H. MCHENRY,
Prin. Ass't Engineer.

ARVID RYDSTROM,
Ass't Engineer.

GREAT NORTHERN RAILWAY LINE.

SEATTLE, Wash., November 25, 1891.

Gentlemen:—

I take pleasure in stating that we have used about 23,000 yards of your P. & B. Pile-Covering and also 2,600 gallons of your P. & B. Paint, the order amounting in all to about $15,000.

This material has been used by us to protect our piling from the teredo along the Seattle water front. It was selected by Col. W. P. Clough, Vice President of the Great Northern Railway, after several months' research in the East as well as on the Pacific Coast.

From what I have seen of the material, as placed upon our piling, I am confident that it is a safe and sure protection against the teredo.

Yours truly,

WM. P. WATSON,

Prin. Ass't Engineer.

OREGON IMPROVEMENT COMPANY.

SEATTLE, Wash., December 9th, 1891.

Gentlemen:—

During the last four years we have used about 10,000 yards of the P. & B. Covering on marine constructions for the Oregon Improvement Company and the Columbia & Puget Sound Railroad Company. Examination of the piles protected with it shows them to be in as good condition as when first driven, while without protection their life would not have exceeded fourteen months.

The covering remains intact, without any evidence of impairment, and from its appearance will last for many years. It has given us such satisfaction that we are now using it on all the piles we are driving.

C. J. SMITH,
Gen'l Mgr.

B. F. BUSH,
Chief Engineer.

THOMAS THOMPSON.

San Francisco, Cal., October 30, 1891.

Gentlemen:—

In regard to your covering for the protection of piles from the teredo and limnoria, I would say that in the year 1884 I built a wharf in the Bay of San Francisco for Messrs. Swanberg & West, treating the piles with your process; to-day, almost eight years later, I find all of them in a state of excellent preservation, while in that locality the average duration of an unprotected pile has been about three years.

Having in the past eight years used your protection very extensively, and having always found it to be as you have represented, I take great pleasure in recommending it to those who may have any piles to drive where exposed to the ravages of the teredo or limnoria.

Yours truly,

Thomas Thompson,

Wharf & Bridge Builder.

THE SAN FRANCISCO & NORTH PACIFIC R. R. CO.

San Francisco, Cal., December 28th, 1889.

We, the undersigned, hereby certify: That we were present at the wharf of the San Francisco & North Pacific R. R. Co., Point Tiburon, on Thursday, December 26th, 1889, and had a pile drawn which we knew to have been driven in the month of October, 1885. That said pile was covered and protected by the Paraffine Paint Company's Patent P. & B. Pile-Covering, protected from chafing by battens before being driven, and that upon being drawn, four years and two months thereafter, it was fouud to be perfectly sound and free from any signs of the work of the teredo and limnoria. The pile-covering was in good condition, though the battens were entirely eaten away.

H. C. Whiting, *General Manager.*
W. G. Corbaley, *Supt.*
N. Dennis, *Sup't Bridges & Buildings.*
P. J. Gildea, *Foreman Pile Driver.*

San Francisco, Cal., November 14, 1891.

Referring to my letter of December 28th, 1889, in regard to your pile covering, I beg to say we are still using it on all new work, and so far as I know, all the piles covered and driven from 1885 to date are still in good condition.

Yours truly,
H. C. Whiting, *Gen'l Mgr.*

THE SEATTLE, LAKE SHORE & EASTERN RAILWAY COMPANY.

Gentlemen:—

SEATTLE, Wash., October 19, 1891.

We have used 19,130 yards of P. & B. Pile-Covering and 2,576 gallons of P. & B. Paint in covering the piles of the Seattle Coal & Iron Company's Madison Street Coal Bunker, and the Seattle, Lake Shore & Eastern Railway Company's coal bunkers at Smiths Cove, as well as part of our extensive trestle along the water front of this City.

The life of unprotected piles in these waters rarely exceeds eleven months, while your material which has now been in our constructions for three years and five months, shows no deterioration, and the piles covered with it are absolutely free from the teredo, and as sound as when first driven.

We are using the P. & B. protection on all the piles we are driving, and take much pleasure in endorsing it as a perfect protection against teredo and limnoria.

Yours very truly,

A. S. DUNHAM,

Vice President, Seattle Coal & Iron Co.,

Pres. & Gen'l Mgr., Seattle, Lake Shore & Eastern R'y Co.

SAN FRANCISCO BRIDGE COMPANY

San Francisco, Cal., October 29th, 1891.

Gentlemen:—

We are familiar with the merits of your pile-covering process, having constructed several wharves and slips for the State Board of Harbor Commissioners, in which the piles were protected with your covering, the Lombard Street Slip alone having 1,500 piles in it protected with your material.

We believe it to be better, more durable and less liable to abrasion in driving the piles than any other methods of covering.

We consider it a valuable and efficient protection against the action of the teredo and other marine worms.

Yours truly,

San Francisco Bridge Company,

J. McMullin, President.

PACIFIC GAS IMPROVEMENT CO.

Gentlemen:— San Francisco, Cal., December 20th, 1887.

I had piles driven in our dock, some built in and others detached, three years ago, which were protected with your Patent Teredo-Proof Covering.

Other piles, driven eighteen months afterwards, for chafing piles, unprotected, were removed this fall, being completely eaten, so that many of them would not stand up at all.

I find the detached piles driven over three years ago as stiff as ever, and examination of the dock piles at extreme low tide, shows the covering intact. I am confident that if the covering is carefully and intelligently used, that it is almost a perfect protection to piles.

Yours truly,

T. H. Eichbaum,

Supt. and Engineer.

Gentlemen:— San Francisco, Cal., October 30th, 1891.

Subsequent experience up to this date (Oct. 30th, 1891), shows that the life of piles covered with P. & B. Pile-Covering is extended at least five times beyond their life if uncovered.

Yours truly,

T. H. Eichbaum,

Supt. and Engineer.

DARBY LAYDON & CO.

San Francisco, Cal., October 29th, 1891.

Gentlemen:—

In reply to your letter asking our opinion as to the value of your preparation for piles, we can say that we have used a vast number of piles prepared by your system, and that we have found it to be better and more lasting than any introduced in this bay.

We have just completed a wharf structure in which about 600 piles were used, all prepared by your system.

Darby Laydon & Co.,
Wharf & Bridge Builders & Gen'l Contractors.

ESQUIMALT AND NANAIMO RAILWAY CO.

VICTORIA, B. C., April 1st, 1891.

Dear Sirs:—

I have much pleasure in stating that the P. & B. paint and pile-covering supplied by you and used on the Union Colliery Co.'s coal wharves at Comox, have given great satisfaction.

The piles to which the paint and covering were applied were driven three years ago, and are now intact, while neighboring piles, not covered, have been renewed long ago.

Yours truly,

JOSEPH HUNTER,

Gen'l Supt.

THE NEW VANCOUVER COAL MINING & LAND CO., LTD.

NANAIMO, B. C., May 13th. 1891.

EXTRACT.—So far as we have examined the piles up to this date, they are perfectly sound. Without the Covering the piles would have been riddled with worm holes long before now.

Yours truly,

SAMUEL M. ROBINS,

Superintendent.

NOTE.—The piles above referred to under date of May, 1891, had been in the water about two years and six months, having been driven in the month of October, 1888.

Besides the foregoing, we refer to the following users of the P. & B. Pile-Covering:

SEATTLE.

H. W. Baker & Co.
F. H. Osgood.
Schwabacher Bros. & Co.
West Seattle Land & Improvement Co.

TACOMA.

Tacoma Land Co.
Tacoma Warehouse & Elevator Co.

SAN FRANCISCO.

B. McMahon & Son.
San Francisco Gas Light Co.
California State Board of Harbor Commissioners.

For further information and other references apply to:—

H. L. GULLINE & CO., SOLE AGENTS,
111 COLUMBIA STREET,
SEATTLE, WASH.

TRADE

MARK

P. & B. PATENT TEREDO PROOF PILE COVERING

H. L. GULLINE & CO.

111 COLUMBIA STREET, SEATTLE, WASH.

SOLE AGENTS FOR STATE OF WASHINGTON AND PROVINCE OF BRITISH COLUMBIA.

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